relevant expertise. However, the actual promulgation of R.F. safety regulations should be done by the Commission, and should be generally patterned after the regulations which currently apply to cellular radio and other related services.[33/]

The ANSI/IEEE standard contains provisions for two categories of individuals -- those in the controlled environment and those in the uncontrolled environment. The uncontrolled environment is the correct category in which to include mobile satellite radio devices because it encompasses persons who generally are unaware of R.F. exposure from the equipment in use.

Motorola fully expects that the IRIDIUM™ system handheld terminals will meet the requirements of the ANSI/IEEE standard, primarily because of their relatively low power. One means of establishing adherence to such a standard would be to limit the handheld power level to meet the "categorical exclusion" of Section 4.2.2.1 of the ANSI/IEEE standard. Whereas this approach may appear to be attractive because of its relative simplicity, it could prove to be unnecessarily restrictive. A mobile satellite system design should be allowed to specify a handheld radio power level which somewhat exceeds this categorical exclusion if it otherwise meets the ANSI/IEEE requirements by employing antenna and radio case design techniques which result in an acceptable Specific Absorption Rate ("SAR"). Therefore, Motorola believes that it would be

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[33/] In the NPRM at paragraph 32, the Commission asks if certain frequencies may be more hazardous than others. The ANSI/IEEE standard accommodates this concern by prescribing limits which are frequency dependent.

inappropriate for the Commission to limit mobile satellite handheld radio power levels to those necessary to meet the ANSI/IEEE categorical exclusion.[34/] Rather, the choice of this parameter should be left to the satellite system designer.

Lastly, adherence to the appropriate standard should be ascertained and demonstrated by each party involved in handheld radio manufacturing at the time of equipment type acceptance. This demonstration could be based upon a categorical exclusion, if appropriate, or by measurement of the SAR. In either case, Motorola is convinced that the safety of mobile satellite users can be assured.

VI. THE COMMISSION SHOULD ALLOCATE ADDITIONAL SPECTRUM FOR MSS INTERSATELLITE SERVICE

Motorola fully supports the Commission's proposals to allocate additional spectrum for intersatellite service above 20 GHz to accommodate crosslinks for MSS systems. NPRM at ¶ 27. Such allocations would be consistent with the decisions reached at WARC-92 and could be used by the IRIDIUM™ system or other MSS systems in the future.[35/]

[34/] For services, such as cellular radio and personal communications, which do not have the system design constraint posed by satellite systems, a limit on handheld radio power levels at the categorical exclusion may be appropriate.

[35/] Motorola anticipates using existing spectrum already allocated for intersatellite service for the first generation IRIDIUM™ system.

VII. MOTOROLA SHOULD BE AWARDED A PIONEER'S PREFERENCE FOR PROPOSING THE FIRST GLOBAL LEO SATELLITE SYSTEM DESIGNED TO PROVIDE PERSONAL MOBILE VOICE COMMUNICATIONS SERVICES

The Commission has tentatively concluded that none of the LEO MSS applicants is entitled to a pioneer's preference under its rules for the asserted technological and service innovations associated with its satellite system. Motorola respectfully disagrees with this preliminary decision as it relates to the denial of Motorola's request for a pioneer's preference for the IRIDIUM™ system.[36/] Motorola also objects to the Commission's apparent use of a group of outside "experts" to judge the merits of its pioneer's preference request without first notifying the applicants that such a panel was going to be consulted on this subject, and without providing Motorola with an opportunity to make presentations to this group of individuals. Such procedures appear to be in violation of the Commission's own policies relating to the processing of pioneer's preference requests.

A. Motorola Is Entitled to a Pioneer's Preference Under the Commission's Rules for the Innovations Associated with the IRIDIUM™ System

In making its initial determination not to grant Motorola's request for a pioneer's preference, the Commission

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[36/] Motorola agrees with the Commission that the other LEO MSS applicants are not entitled to pioneer's preferences in this proceeding.

failed to recognize the essential innovative technologies and services associated with the IRIDIUM™ system, and misapplied its own rules in the process. The Commission apparently denied Motorola's request because certain of the technologies which are employed in the IRIDIUM™ system have previously been used in other military satellite systems, and because Motorola had not provided detailed subsystem designs so as to demonstrate fully the technical feasibility of its overall system design.[37] NPRM at ¶¶ 49-50. Had the Commission properly applied its pioneer's preference rules to the substantial record presented by Motorola in support of its request, it would have awarded a tentative preference to Motorola. The Commission should therefore award Motorola a final pioneer's preference at the time it issues new rules in this proceeding.

1. Standards for Reviewing Pioneer's Preference Requests

Pursuant to the standards articulated by the Commission for awarding pioneer's preferences, Motorola's request clearly should have been granted. As the Commission has observed, "[i]n determining . . . whether to grant a pioneer's preference, [it] will consider whether the applicant has demonstrated that it (or its predecessor-in-interest) has developed an innovative proposal

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[37] In fact, Motorola has substantially completed the design of all major subsystem components of the IRIDIUM™ system. If the Commission concludes that Motorola is entitled to a pioneer's preference but for the submission of this information, Motorola would consider submitting this highly proprietary data to the Commission on a confidential basis.

that leads to the establishment of a service not currently provided or a substantial enhancement of an existing service."[38] This standard was meant to be "as specific as possible . . . without being so inflexible as to undermine its purpose of fostering new spectrum-based technologies and services."[39]

Most recently, the Commission indicated that "the rationale for granting a pioneer's preference is that the requester is responsible for one or more significant innovations that relate to communications technology and service and has invested significant effort in developing the innovation and pursuing authorization of its implementation."[40] Furthermore, each proposal must be innovative and have merit, and the requester must be the original developer and proponent of the innovation.[41] The Commission has articulated a four-part test for analyzing pioneer's preference requests: (1) whether the proposal constitutes a significant communications innovation; (2) whether the requester is the party responsible for the claimed innovation; (3) whether the requester has made a significant contribution in developing the innovation; and (4) whether the innovation reasonably will lead to establishment of a service not

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[38] See Establishment of Procedures to Provide a Preference, Reconsideration Order, 7 FCC Rcd. 1080, 1813 (1992).

[39] Id. at 1809.

[40] Amendment of the Commission's Rules to Establish New Personal Communications Services, 7 FCC rcd. 5676, 5734 ¶ 146 (1992).

[41] Id.

currently provided or substantially enhance an existing service.[42/] Factors to be considered in making this last determination include added functionality, new use of spectrum, changed operating or technical characteristics, increased spectrum efficiency, increased speed or quality of information transfer, technical feasibility, and reduced cost to the public.[43/] Motorola's IRIDIUM™ system clearly meets this test.

2. The IRIDIUM™ System Constitutes a Significant Communications Innovation

In preliminarily concluding that Motorola was not entitled to a pioneer's preference, the Commission incorrectly focused upon a few specific technological features of the IRIDIUM™ system, rather than Motorola's overall service concept. Moreover, the Commission failed to address several innovative service features and technologies associated with the IRIDIUM™ system.[44/] Motorola has also significantly improved its satellite system design and overall performance since the filing of its original application and the Commission's tentative

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[42/] Id. at ¶ 147.

[43/] Id.

[44/] Motorola identified a number of innovative features of the IRIDIUM™ system which the Commission did not even consider, including: (1) virtually universal worldwide coverage; (2) distributed processing systems in orbit using intersatellite links; (3) soft, troublefree cell and satellite-to-satellite handoffs, and the method for predicting such handoffs; (4) a power management system whereby overlapping cells are turned off as satellites approach the polar regions; and (5) devices for narrowband Doppler compensation which conserve power and can be used with handheld communications units.

decision in this proceeding. On August 10, 1992, Motorola filed an amendment to its application with the Commission which presented several refinements to the IRIDIUM™ system, including increased flexibility in allocating system capacity by region and service type, as well as more spot beams and fewer satellites for achievement of greater efficiency and higher link margins.[45/]

First and foremost, Motorola noted that it was the originator of the concept of a LEO satellite system primarily designed to provide personal mobile voice communications services to anyone, anywhere, anytime in the world using subscriber units that are small, lightweight, pocket-sized, battery-operated, and have low-profile antennas.[46/] The IRIDIUM™ system design has resulted in a revival in consideration of LEO satellites for real-time voice and other telecommunications. Motorola has taken an old concept -- LEO satellites -- and surrounded that concept with many highly advanced subsystems, and thereby created a new, innovative personal mobile communications system.

The technological innovations encompassed in the IRIDIUM™ system will enable, for the first time, persons anywhere in the world to communicate with one another using portable handsets. Such communications will include digital voice, data,

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[45/] See Minor Amendment to IRIDIUM™ System Application (August 10, 1992). Many of these changes resulted from Motorola's extensive experiments and testing program which demonstrated the need for increased link margins in order to serve the handheld portable market during line-of-site as well as obstructed conditions on the Earth. The results from several of these studies were submitted to the Commission on a confidential basis. See Confidential Appendix (Redacted), PP-32 (May 20, 1992).

[46/] See Supplement to Request for Pioneer's Preference, PP-32, at 6- 8 (April 10, 1992).

paging and RDSS, and provide for interconnection to the public switched telephone network. While others have proposed the commercial and noncommercial use of LEO satellites in the VHF/UHF bands ("little" LEO's), Motorola's personal communications vision is substantially different from those satellite systems. The "little" LEO's are primarily directed at providing store-and-forward data communications services over a relatively small bandwidth. The IRIDIUM™ system, on the other hand, will be capable of providing worldwide voice communications on a real-time basis to tens of thousands of users simultaneously. Furthermore, unlike the proposed "little" LEO systems, the IRIDIUM™ system constellation will ensure universal service to virtually any point on the Earth on a continuous basis.

3. Motorola is the Party Responsible for Developing the Claimed Innovations

Motorola also has demonstrated in this proceeding that it is the true pioneer of these developments by having brought out the capabilities or possibilities of the technology and service, and having brought them to a more advanced or effective state. No one has seriously questioned Motorola's assertions that it began development of the key components of the IRIDIUM™ system over five years ago, well before any other LEO MSS applicant indicated any real interest in this subject.[47/]

[47/] See Supplement to Request for Pioneer's Preference, PP-32, at 4-6.

Moreover, the prior use of certain technologies associated with the IRIDIUM™ system in military satellite systems is irrelevant to a determination as to whether Motorola has made a significant contribution in developing its personal satellite communications system. In this regard, the Commission has failed to provide any rational basis for distinguishing between its treatment of Motorola's request and the tentative award given to Volunteers in Technical Assistance ("VITA") for its proposed "little" LEO satellite system. In the "little" LEO proceeding, the Commission awarded a tentative preference to VITA based upon its application for civilian purposes of proven LEO store-and-forward communications technologies, which Motorola believes have previously been used by other satellite systems.[48/]

4. Motorola Has Made a Significant Contribution in Developing LEO MSS

To date, Motorola has spent over $100 million dollars in the basic research and development of the IRIDIUM™ system and in pursuing authorization of its implementation in the United States and throughout the world. This considerable effort has resulted in the development of the innovations noted above,

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48/ See Allocate Spectrum for Fixed and Mobile Satellite Services for Low-Earth Orbit Satellites, Tentative Decision, 7 FCC Rcd. 1625 (1992). Motorola is not suggesting that the Commission was wrong to award a pioneer's preference to VITA for the innovations associated with its civilian data communications proposal. To the contrary, Motorola simply requests that the Commission apply the same standards to both VITA's and Motorola's requests, and award both entities a pioneer's preference.

including several patents for key components of the IRIDIUM℠ system.

5. The Innovation Reasonably Will Lead to the Establishment of a Service not Currently Provided or Substantially Enhance an Existing Service

The IRIDIUM℠ system will lead to the establishment of mobile communications services not currently being offered, as well as the substantial enhancement of existing mobile communications services. To date, commercial land mobile satellite communications have been limited primarily to position location and data services in the transportation and shipping industries. Voice grade land mobile satellite communications services by a U.S. licensee will not be available in the United States for several years at best. Even these services will require relatively bulky ground equipment for reception from and transmission to geostationary satellites. The IRIDIUM℠ system will establish, for the first time, a global LEO personal voice communications service available to anyone, anywhere, anytime in the world using subscriber units that are small, lightweight, pocket-sized, battery-operated, and have low-profile antennas.

Furthermore, this new service will offer, among other things:

- An added functionality provided to a broader group of customers;
- A use of the spectrum different than previously available;

- A change in the operating or technical characteristics of a service; and
- Efficiencies in spectrum use, speed or quality of information transfer.[49/]

In this regard, Motorola's and VITA's pioneer's preference requests are quite similar. VITA was granted a tentative preference because it was perceived to be the first to develop LEO data communications technology and to experiment with the operation of an actual LEO system to support data communications in the VHF spectrum. Specific technological innovations associated with VITA's proposed system included direct terminal-to-terminal network operations between ground stations without any hubs or gateways. VITA thus was viewed as the pioneer of LEO satellites for civilian data communications at VHF frequencies.[50/] Similarly, Motorola must be viewed as the first to develop and demonstrate the utility of a LEO MSS system using L-band frequencies for commercial voice communications purposes, and therefore is entitled to a pioneer's preference.

B. The Commission Erred When it Secretly Formed a Group of Outside Experts to Advise it on the Pending Pioneer's Preference Requests in this Proceeding

Motorola understands that five individuals employed by various government agencies (other than the FCC) were asked by

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[49/] See Establishment of Procedures to Provide a Preference, Report and Order, 6 FCC Rcd. 3488, 3494 (1991).

[50/] See Allocate Spectrum for Fixed and Mobile Satellite Services for Low-Earth Orbit Satellites, Tentative Decision, 7 FCC Rcd. at ¶¶ 15-16.

the Commission to review Motorola's pioneer's preference request and provide their expertise as to the merits of this request. The use of these "experts" was done without the knowledge or approval of Motorola or any of the other LEO MSS applicants, and without notice to the public at large. Motorola only became aware of this panel of experts shortly before the Commission's open meeting wherein the NPRM was voted upon by the Commissioners. No opportunity was provided for any of the applicants to appear before this group or answer questions any of them might have had concerning the merits of Motorola's application or system design.

The use of such a secret panel of experts appears to violate the spirit, if not the letter, of the Commission's pioneer's preference procedures. Indeed, when the Commission adopted its pioneer's preference rules, it observed that it "may wish to seek the opinion of specific individuals -- recognized experts in scientific disciplines that are relevant to proposals before the Commission."[51/] The Commission further promised, however, that the product of such "peer review" would be placed in the public record and evaluated along with other comments in the proceeding. Id. In this case, the secret panel of experts rendered their opinions to the Commission staff without the benefit of any public comment.

The Commission ultimately must make an informed decision as to the merits of each pioneer's preference request that comes before it. The public cannot be assured that the

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51/ Pioneer's Preference Report and Order, 6 FCC Rcd. at 3494.

Commission has relied upon only relevant factors in making this crucial determination unless all parties to the proceeding have an opportunity to review and comment upon the opinions of outside experts. At minimum, the Commission should have allowed each of the parties to present additional materials to these experts and review their findings and opinions before any Commission decision. In this case, the Commission can correct this error by now allowing the parties to review the reports of these experts and comment upon them. Alternatively, the Commission should consider holding a hearing limited to a determination as to the technical innovations associated with the IRIDIUM™ system.

VIII. CONCLUSION

For the foregoing reasons the Commission should adopt the proposed primary and secondary MSS allocations, and award

Motorola a pioneer's preference for the innovations associated with the IRIDIUM™ system.

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December 4, 1992

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I, Philip L. Malet, hereby certify that the foregoing Comments were served by first-class mail, postage prepaid, this 4th day of December, 1992 on the following persons:

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ATTACHMENT A

CCIR FACT SHEET

STUDY GROUP: U.S. JIWP
DOC. NO. U.S. JIWP-16 (Rev 1)

DATE: JANUARY 31, 1991
REF: REPORT OF IWP 8/15
TO THE JIWP

DOCUMENT TITLE

AMENDMENT OF SECTION 6.1.1.3.1.4 ON SPECTRUM NEEDS FOR LOW EARTH ORBIT MOBILE SATELLITE COMMUNICATIONS ABOVE 1 GHz

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PURPOSE/OBJECTIVE:

This contribution proposes to amend Section 6.1.1.3.1.4 to include the amount of spectrum required for Low Earth Orbiting (LEO) mobile-satellite communications. This was an open issue in the Report of the IWP 8/15 to the JIWP WARC-92. The spectrum needs are based upon projected user demand.

ABSTRACT:

This report provides the basis for the spectrum required for a LEO system to serve the MSS market. It uses market predictions and analysis of the peak busy hour locations to determine the required spectrum. Further analysis takes projected user growth rates to quantify future spectrum requirements through the year 2010. This report concludes 40.8 MHz of spectrum should be made available in year 2001 increasing to 96.3 MHz in year 2010 for LEO MSS systems to meet the future demand.

CCIR JIWP/WARC-92
Geneva, Switzerland
4 - 15 March 1990

Doc: JIWP USA-16 (Rev 1)
Date: 31 January 1991
Original: English

AMENDMENT OF SECTION 6.1.1.3.1.4 ON SPECTRUM NEEDS FOR LOW EARTH ORBIT MOBILE SATELLITE COMMUNICATIONS ABOVE 1 GHz

The following amendments are proposed to Section 6.1.1.3.1.4 on matters regarding the amount of spectrum which should be made available to accommodate Low Earth Orbit (LEO) Mobile-Satellite Services above 1 GHz. An annex provides rationale for the proposed changes.

1. Replace the second sentence of the first paragraph with:

A study was completed to better describe the traffic demand for mobile satellite communication services which would be served by LEO systems. The study covered three areas (1) sparsely populated regions where there is insufficient demand to justify constructing terrestrial fixed or mobile telephone systems; (2) areas in many developing countries with little or no existing telephone service; and (3) low density urban areas that do not now have a terrestrial mobile communications infrastructure.

2. Add the following new paragraph after the current second paragraph:

LEO MSS spectrum requirements are estimated to be 40.8 MHz in 2001 increasing to 96.3 MHz by 2010. These LEO spectrum needs are not necessarily additive to the GSO spectrum needs which follow. For derivation of LEO MSS Spectrum requirements above 1 GHz, see Appendix V to Doc. IWP 8/15-1.

3. Add the following as Appendix V of the Report of IWP 8/15 to the JIWP WARC-92, 21 November 1990:

APPENDIX V

SPECTRUM NEEDS FOR LOW EARTH ORBIT MOBILE SATELLITE COMMUNICATIONS ABOVE 1 GHz

Low earth orbit (LEO) mobile satellite communications above 1 GHz offer the potential to add a direct personal communications capability to existing and planned mobile satellite services. The LEO system characteristics include frequency reuse potential of approximately 6 times in a large area such as the contiguous United States and 233 times worldwide. The satellite/user terminal link could operate bi-directionally, transmitting and receiving in a single band.

A study was completed to better describe the traffic demand for mobile satellite communication services which would be served by LEO systems. The study covered three areas (1) sparsely populated regions where there is insufficient demand to justify constructing terrestrial fixed or mobile telephone systems; (2) areas in many developing countries with little or no existing telephone service; and (3) low density urban areas that do not now have a terrestrial mobile communications infrastructure. The categories of potential users included government, international and domestic travel, commercial aircraft, general and business aviation, recreational vehicles, luxury pleasure boats, coastal and inland shipping, construction and natural resource exploration, and public telephone.

From these market predictions, analysis of the voice traffic peak busy hour locations were used to determine the estimated spectrum needed for the years 2001, 2005, and 2010. The future spectrum requirements accounted for both expected user growth and technology improvements. Spectrum requirements were based upon the following peak busy hour data:

Voice Users in Peak Busy Hour Location = 722,500
Holding Time = .02 erlang/user
Bandwidth = 13.64 KHz in each frequency reuse area
Frequency Reuse Factor in Peak Busy Hour Location = 5.71
Required Blocking = 2 percent

LEO MSS SPECTRUM REQUIREMENTS
(MHz)

(YEAR)

2001	2005	2010
40.8	59.8	96.3

ANNEX I

SPECTRUM NEEDS FOR LOW EARTH ORBIT MOBILE SATELLITE COMMUNICATIONS ABOVE 1 GHz

1. INTRODUCTION

In response to the Report of the IWP 8/15 to JIWP WARC-92, an open issue (paragraph 6.1.1.3.1.4) was the amount of spectrum required for low earth orbiting systems to provide mobile satellite service (MSS) communications. This contribution provides a basis for and describes the spectrum requirements. Demand predictions through the year 2010 are used to predict the spectrum required to provide service to peak busy hour locations. By focusing on the peak busy hour situation, analysis can identify the spectrum required to service all worldwide locations.

2. DEMAND FOR LOW EARTH ORBIT MOBILE SATELLITE COMMUNICATIONS

The phenomenal growth of the Public and Private land mobile radio confirms a very large need in the United States and throughout the world for mobile communications. For example, within the United States, multi-channel trunked systems have maintained an annual growth rate of over 30 percent during the last five years.[1] Potential users number in the tens of millions. While the requirements for satellite-based mobile communications are not expected to be as large as those for terrestrial mobile communications, MSS needs are, nonetheless, expected to be substantial.

Low Earth Orbit (LEO) Satellite-based mobile service communications will be commercially successful in areas that cannot be served by other mobile communications services. The areas include (1) sparsely populated regions where there is insufficient demand to justify constructing terrestrial fixed or mobile telephone systems; (2) areas in many developing countries with little or no existing telephone service; and (3) low density urban areas that do not now have a terrestrial mobile communications infrastructure.

ANNEX II provides a detailed description of each category of user need for the LEO MSS including size and probable utilization. A summary of LEO MSS forecast user data is shown in Table 1.

3. SPECTRUM REQUIREMENTS

This spectrum requirements discussion is limited to those needs which can be satisfied in the 1-3 GHz spectrum by LEO MSS. The spectrum needs reflected in this study, where applicable, can provide priority access with real-time preemptive capability over all other communications in the mobile-satellite service for aeronautical and maritime distress and safety communications.

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[1] IWP 8/15 USA-10, "The Land Mobile Radio Service For Private Use," 8 November 1990.

The technical characteristics of the LEO MSS system were described in "Technical Characteristics of a Personal Communication Mobile Low Earth Orbit Satellite System" approved at the IWP 8/14 meeting in Melbourne, Australia, and included as Annex IX of the IWP 8/15 report to Working Group 8.

Table 1
LEO MSS USER DEMAND SUMMARY
(BY YEAR 2001)

Category of Users	U.S. Addressable Users	U.S. Users	Non-U.S. Users	Total Users
Government	14,000,000	56,000	1,120,000	1,176,000
International Travel	50,000	30,000	120,000	150,000
Commercial Aircraft	5,000	2,500	2,500	5,000
General Aviation	200,000	10,000*	5,000*	15,000*
Business Aircraft	14,000	3,000*	2,000*	5,000*
Recreational Vehicles	8,000,000	400,000	100,000	500,000
Luxury Pleasure Boats	300,000	210,000	210,000	420,000
Coastal and Inland Shipping	30,000	8,000	40,000	48,000
Construction, Oil and Mineral Exploration	10,000	5,000	15,000	20,000
Public Telephone	---	---	300,000	300,000
Domestic Business Travel	---	---	300,000	300,000
Totals	22,609,000	722,500	2,214,500	2,937,000

* NOTE: These numbers reflect the estimated maximum number of potential active users at one time. The actual number of aircraft equiped is much higher.

SOURCE: Application for a Low Earth Orbit Mobile Satellite System by Motorola Satellite Communications, Inc. to the Federal Communications Commission, Washington, D.C., December 3, 1990.

3.1 DETERMINING THE PEAK BUSY HOUR LOCATION

The world-wide spectrum requirements are driven by the spectrum needed to provide service to the most densely used portion of the LEO MSS intended service areas identified in Section 2 during the peak busy hour. The analysis which follows is based upon the user demand summary presented in Table 1. Note since satellite antenna cells serve all users within their geographic regions, the sum of land, aeronautical, and coastal and inland shipping users was used to determine the peak busy hour demand. Voice service will put the greatest demands on spectrum requirements; therefore, the analysis which follows will be based on the spectrum required to service the voice need. Spectrum required for pure Data and position location needs are omitted for simplicity. Table 2 further refines the Table 1 information by comparing the user density over the land area of the United States with the land area of the total world. Table 2 clearly shows that the density of users will be highest in the United States. This is the geographic area

chosen for the peak busy hour spectrum calculations which follow. Geographic frequency reuse over the U.S. is 5.71 and 232.6 worldwide.[2]

TABLE 2

LEO MSS LAND MOBILE VOICE USERS

(BY YEAR 2001)

	U.S.	TOTAL WORLD
USERS	722,500	2,937,000
GEOGRAPHIC FREQUENCY REUSE	5.71	69.7*
USER/GEOGRAPHIC FREQUENCY REUSE AREA	126,532	42,137

* 69.7 = 232.6 x 30 % (30 percent of the earth's surface is land area)

3.2 COMPUTING THE SPECTRUM REQUIREMENT

The formula used to determine the spectrum required to meet market demands is:

$$S = 1.05 \left[\frac{T \times U \times BW}{R} \right]$$

NOTE: The 1.05 factor represents the additional spectrum required to compensate for the time between one user relinquishing a channel and another taking it.

S = Spectrum Required
T = Total Number of Users
U = Holding time (Erlang/User)
BW = Bandwidth/Channel in each Frequency Reuse Area
R = Geographic Frequency Reuse

Using the information from Table 2, the LEO MSS spectrum requirements for the year 2001 are computed using the following peak busy hour values:

T = 722,500 Users
U = .02 (Erlang/User)
BW = 13.64 KHz/ Channel in each frequency reuse area
R = 5.71

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[2]There are 40 LEO MSS cells over the United States and 1628 worldwide which have a 7 cell frequency reuse factor. Therefore, the geographic frequency reuse is 5.71 (40/7) over the United States and 232.6 (1628/7) worldwide.